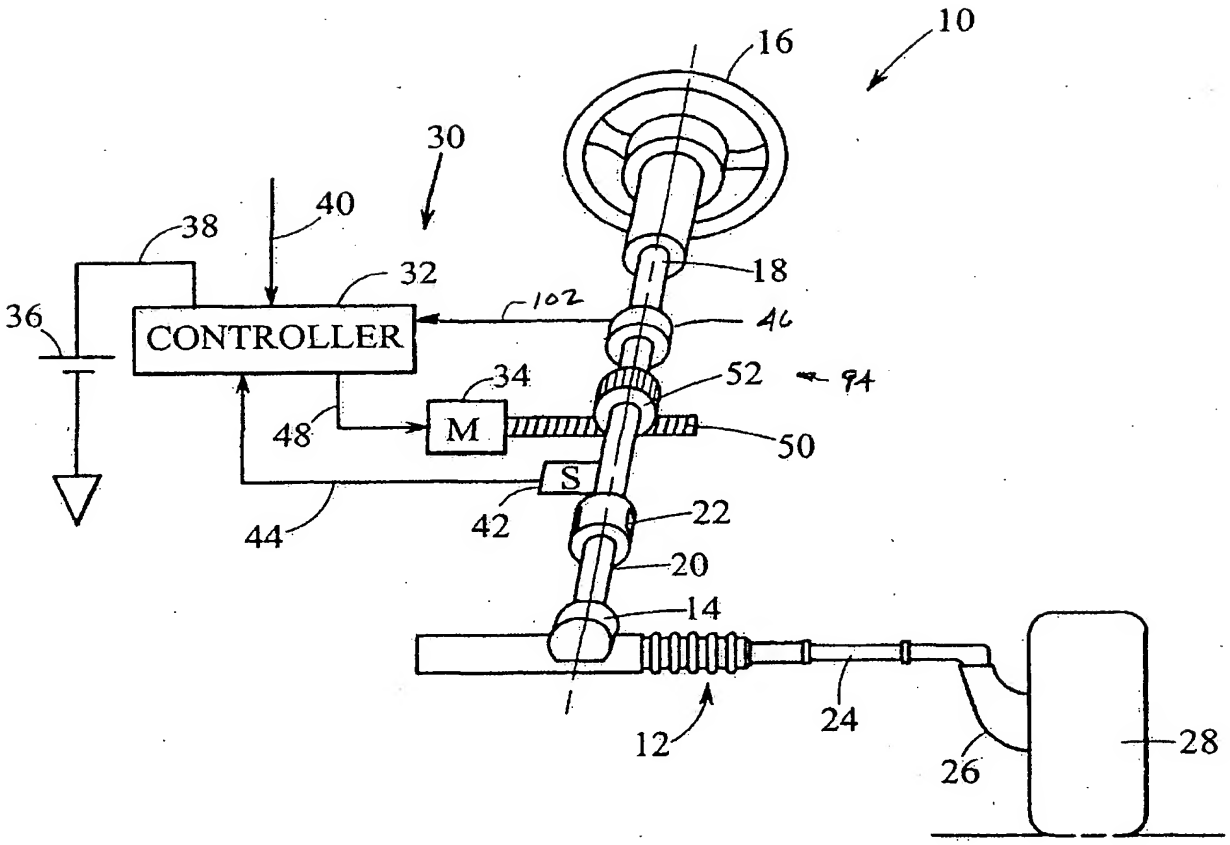
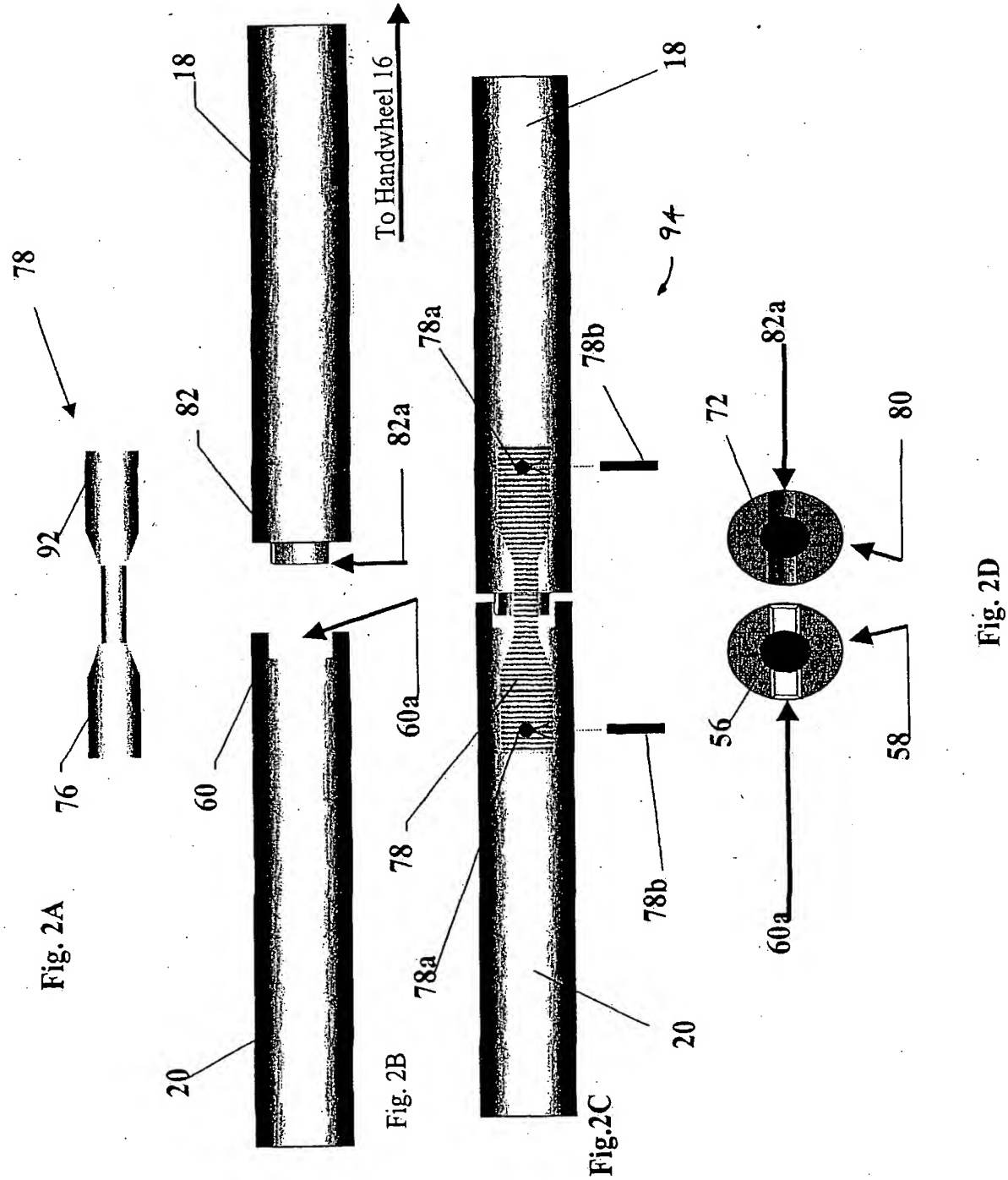
FIG. 1


10
16
30
40
38
32
18
102
36
CONTROLLER
46
34
52
94
48
M
50
S
42
22
44
20
14
12
24
26
28


78
92
76
Fig. 2A
18
82
82a
60
60a
20
Fig. 2B
To Handwheel 16
18
78a
78b
78
78a
78b
20
Fig.2C
94
82a
72
80
56
58
60a
Fig. 2D

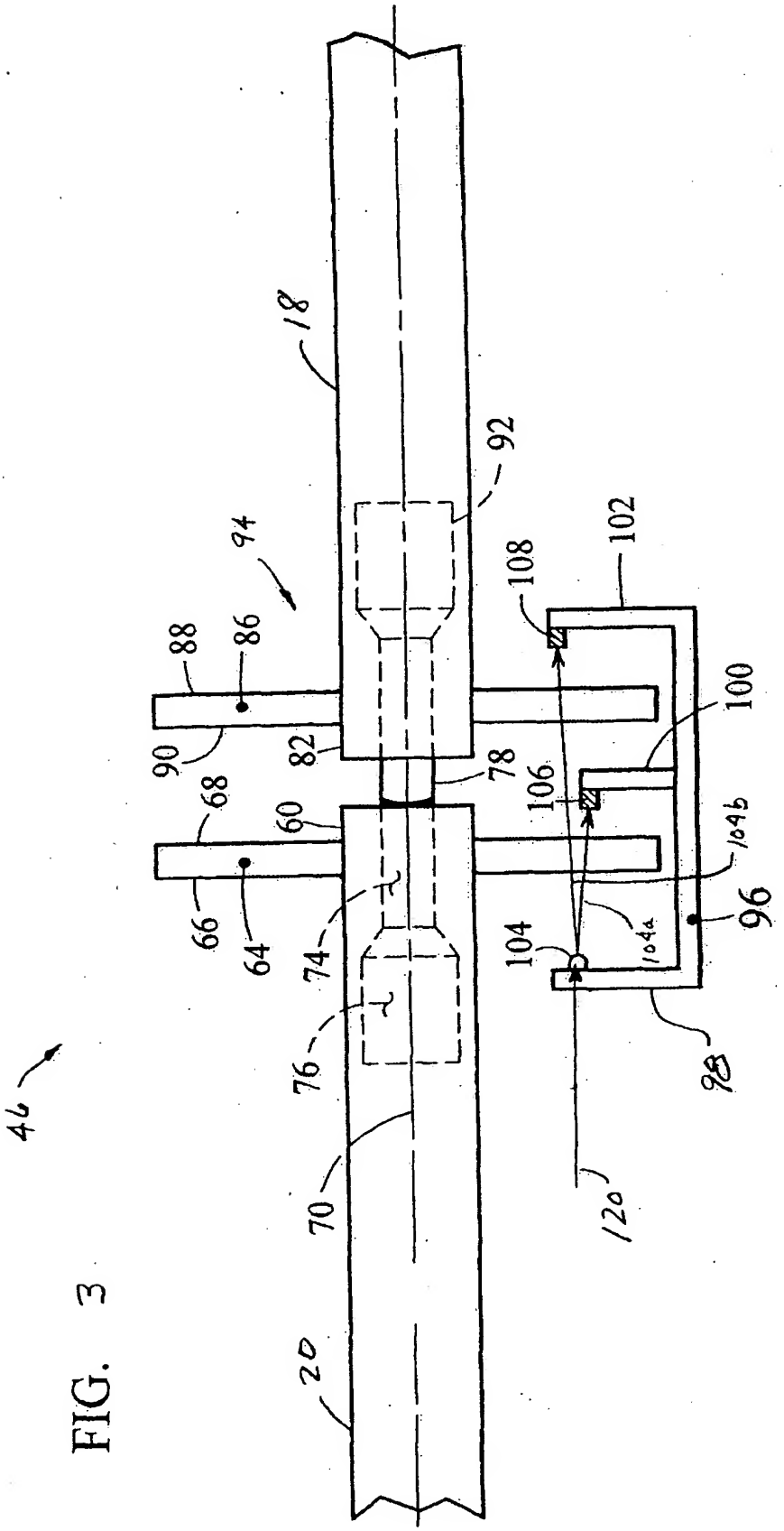

46
18
20
92
94
102
108
88
86
90
82
78
100
106
68
60
104b
66
64
74
104
104a
96
76
98
70
120

FIG. 3

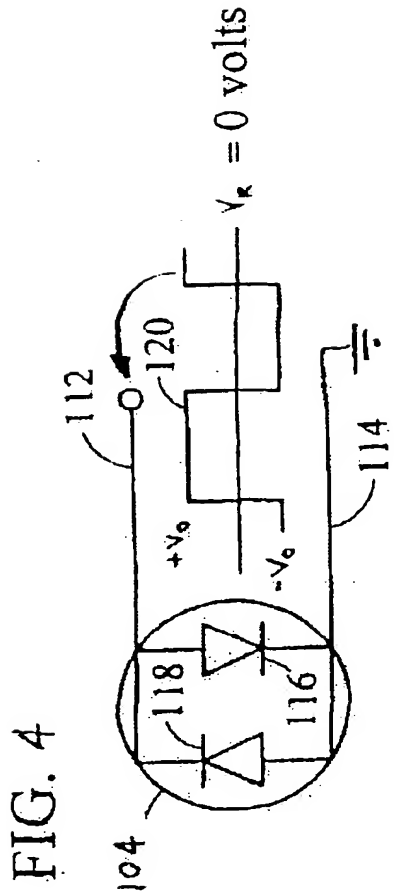


FIG. 4

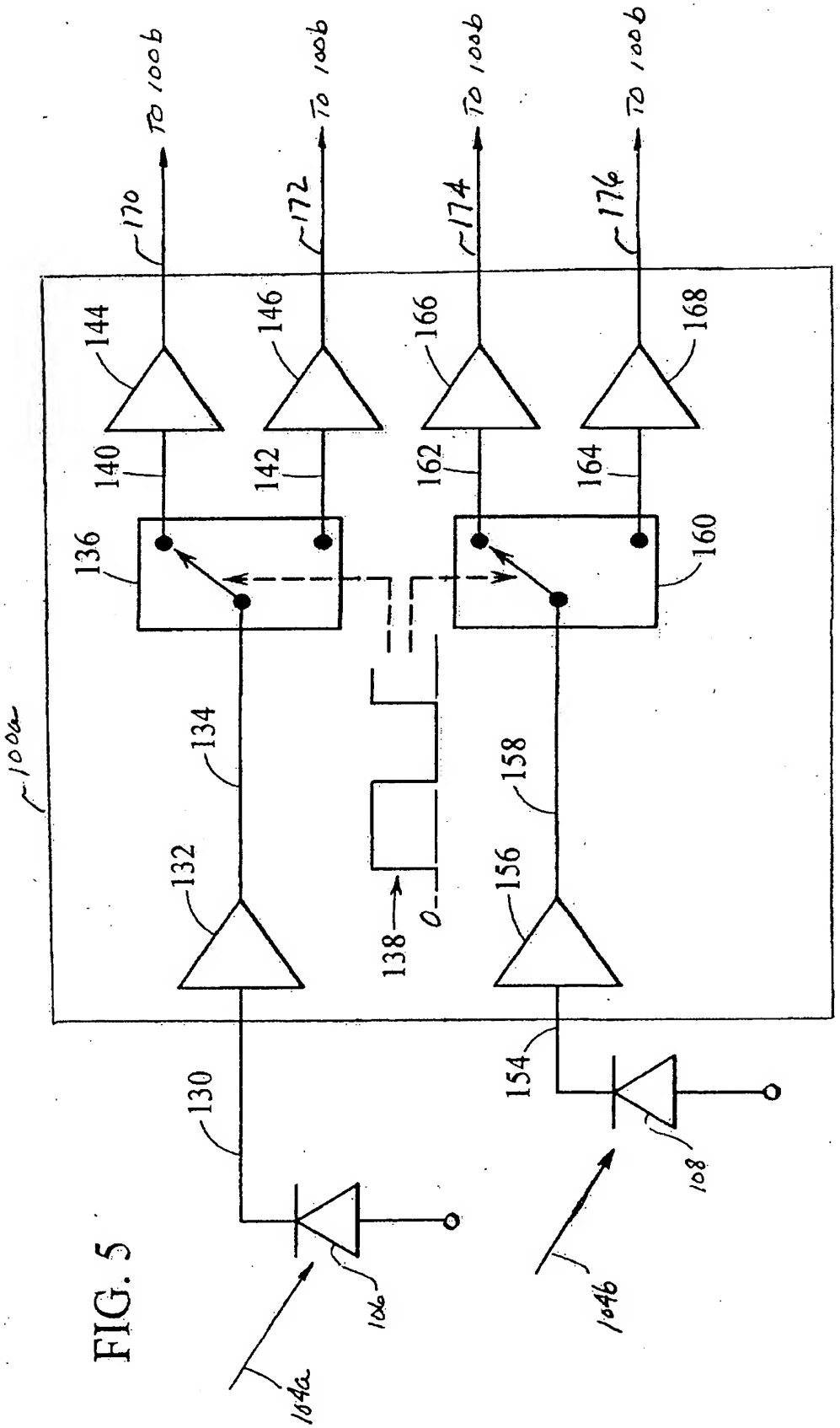

To 100b
To 100b
To 100b
To 100b
170
172
174
176
144
146
166
168
140
142
162
164
136
160
134
158
132
156
138
0
130
154
108
106
104a
104b
100a

FIG. 5

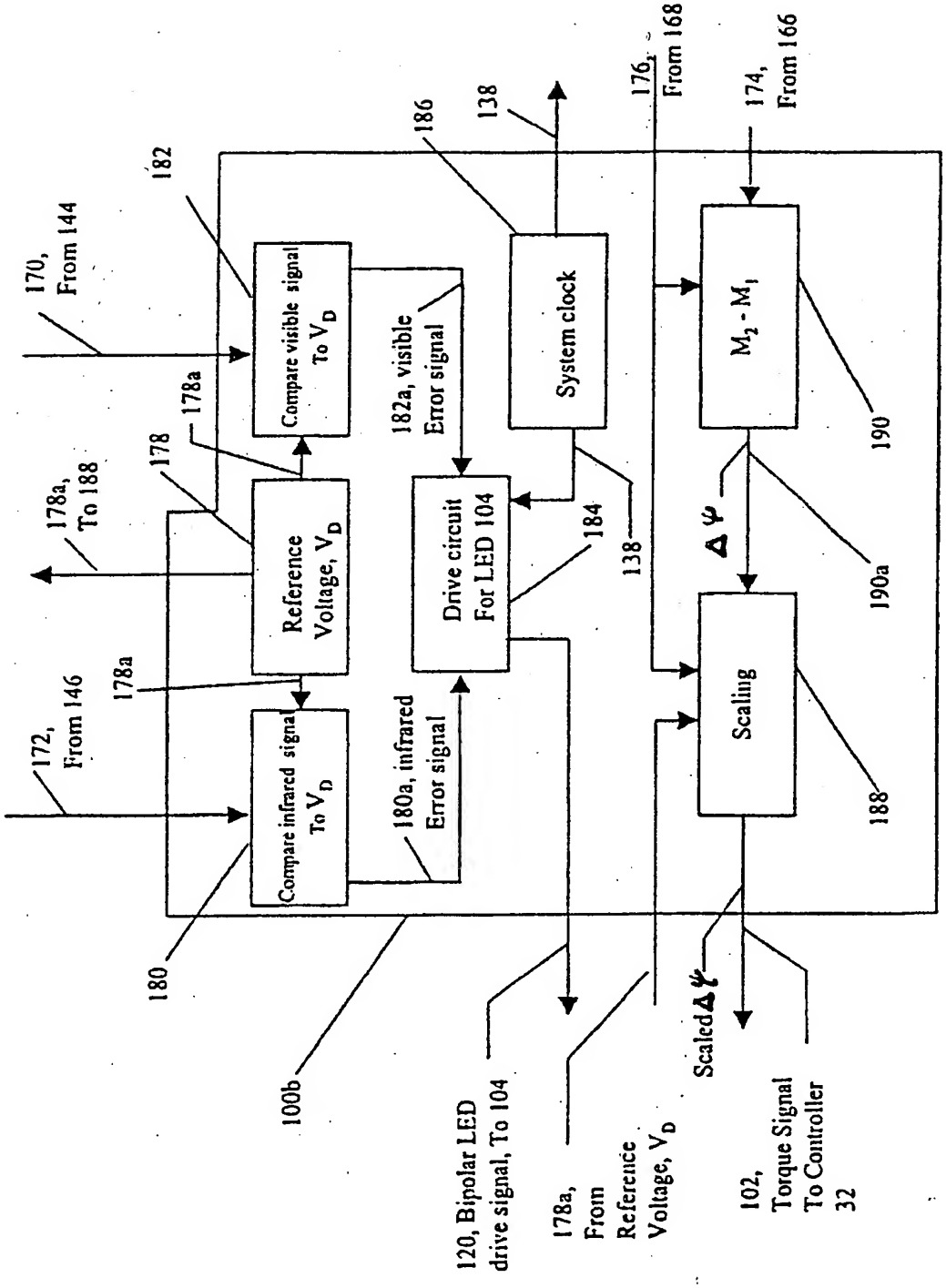

170, From 144
182
Compare visible signal To V_D
178a
178
178a, To 188
Reference Voltage, V_D
172, From 146
178a
Compare infrared signal To V_D
180
100b
182a, visible Error signal
180a, infrared Error signal
Drive circuit For LED 104
184
138
System clock
186
138
176, From 168
174, From 166
$M_2 - M_1$
190
$\Delta\psi$
190a
Scaling
188
Scaled $\Delta\psi$
120, Bipolar LED drive signal, To 104
178a, From Reference Voltage, V_D
102, Torque Signal To Controller 32

Figure 6

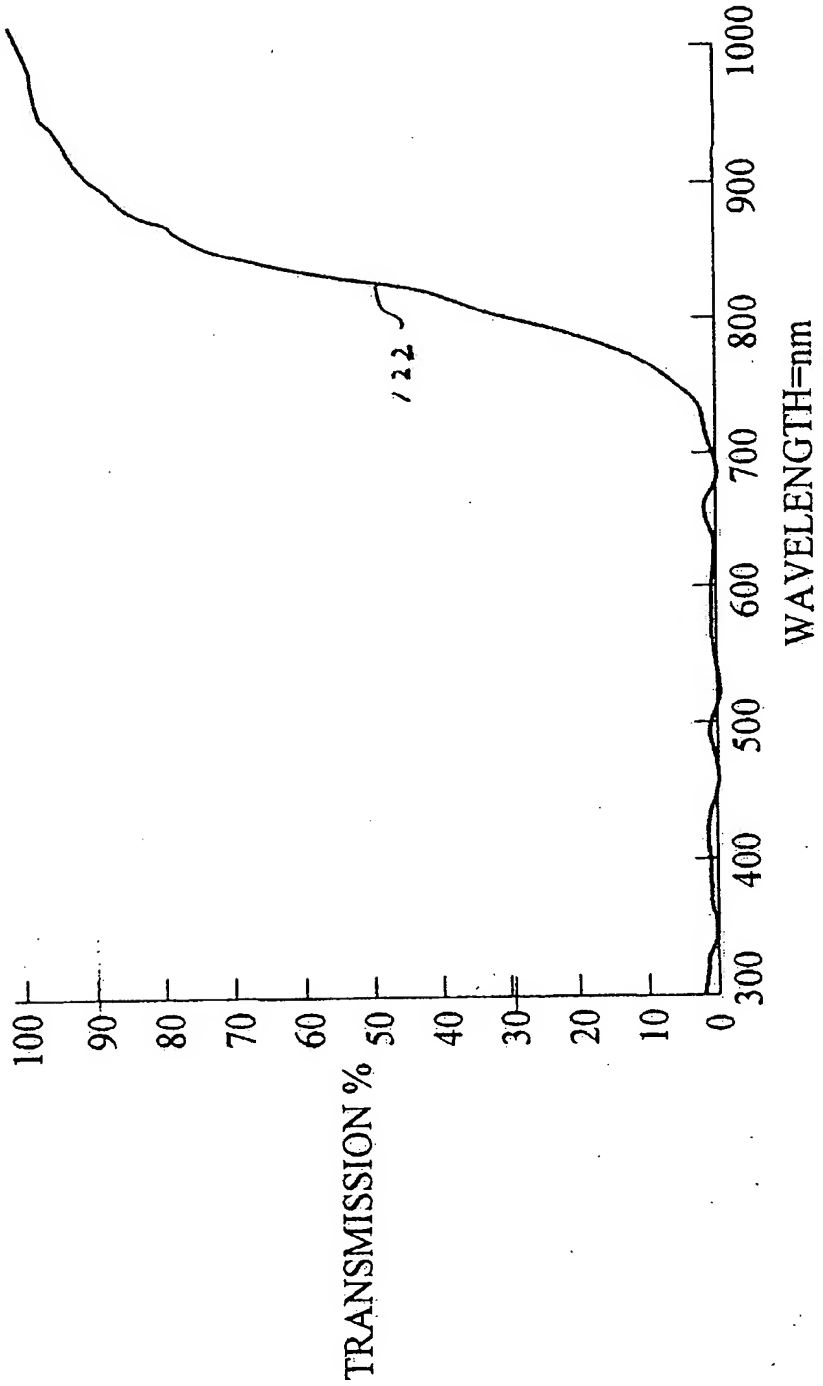

100
90
80
70
60
50
40
30
20
10
0
TRANSMISSION %
300
400
500
600
700
800
900
1000
WAVELENGTH=nm
122

FIG. 7

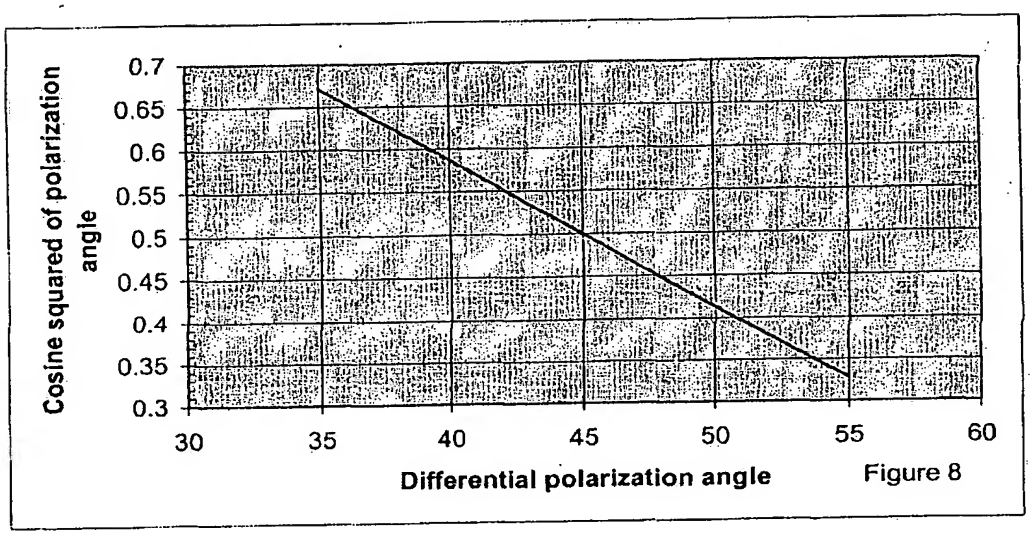


Figure 8

FIG. 8

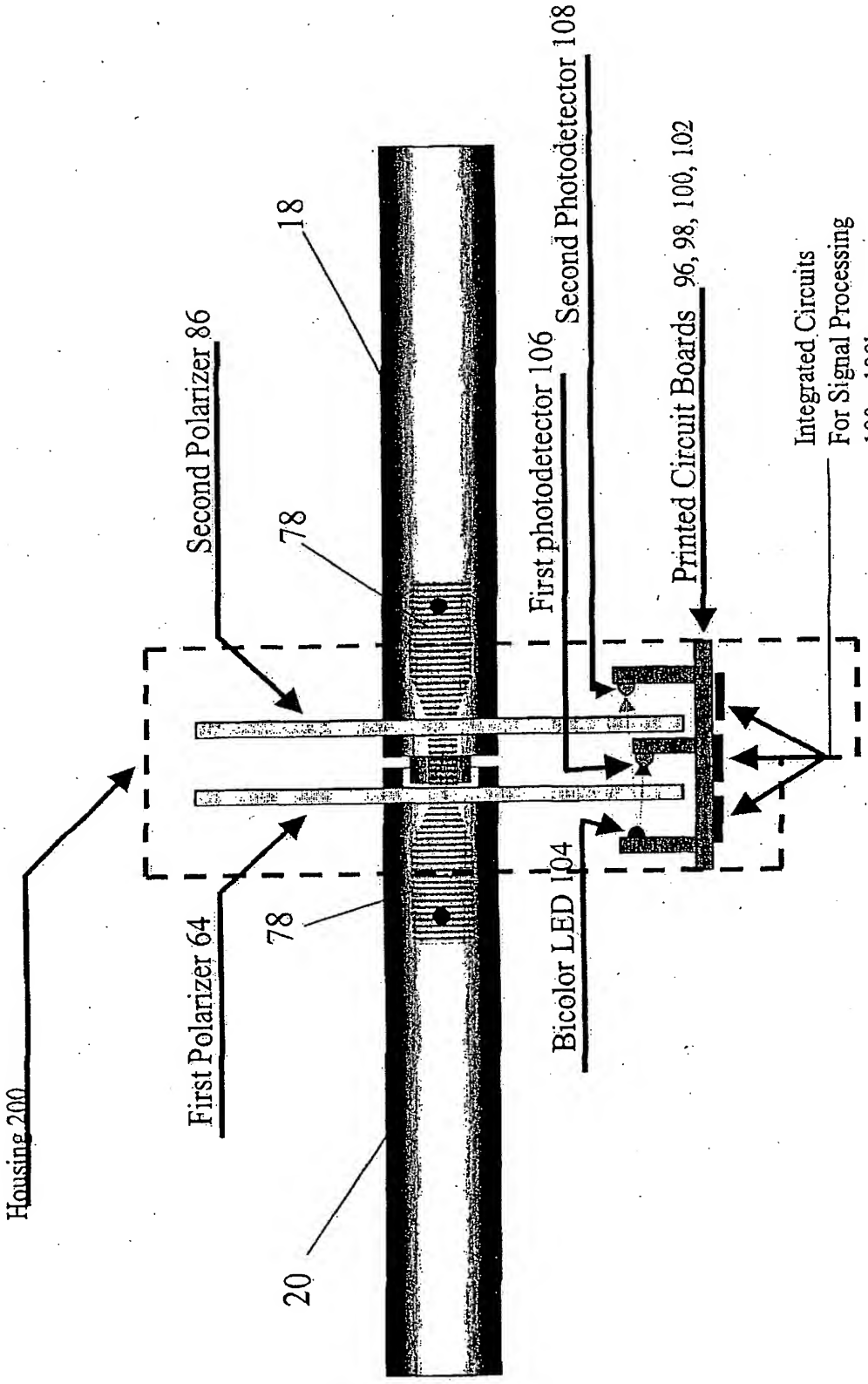

Housing 200
First Polarizer 64
Second Polarizer 86
18
78
78
20
Bicolor LED 104
First photodetector 106
Second Photodetector 108
Printed Circuit Boards 96, 98, 100, 102
Integrated Circuits
For Signal Processing
100a, 100b

Figure 9